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COLORADO STATE UNIVERSITY EXTENSION SERVICE

Irrigation wells—treatment and prevention of bacterial growth

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Quick Facts

- Bacterial slimes cause plugging action in pumps and pipes.
- Bacterial slimes are common in wells tapping the Ogallala aquifer.
- Bacteria can be spread from well to well.
- Lye treatments will dissolve bacterial slimes in wells.
- Lye is a dangerous chemical when used carelessly.
- Bacterial growth can be controlled by well chlorination or certain turbine oil additives.
- The bacteria are composed of water and carbon, plus minor amounts of iron and sulfur.

Bacterial growths of varying degree can be found in many irrigation wells in the deep-well aquifers of eastern Colorado and similar aquifers in Kansas, Oklahoma and Texas. These bacteria appear to be an iron type and are nonpathogenic. However, the bacteria can be harmful in three ways.

1) Bacteria form a slimy coating of up to ½-inch (1.3 centimeters) thick inside pipes and pump columns. This increases friction losses and pumping costs.
2) Bacteria cause well water to be foul tasting, discolored and unfit for drinking.
3) Bacteria **may** cause plugging of the well screen or perforated well casing. (This has not been proved in Colorado.)

Detecting Bacteria

Irrigators can easily detect the bacterial slime problem by the water's foul taste and putrid odor. The irrigator can find further evidence of bacterial growths by checking end plugs in pipelines for slime particles or by catching the particles in a white cloth held in the pump stream.

Bacteria of this type are usually in the yellow-green color range and are greasy to the touch. Particles of bacteria can be dislodged by brisk surging of the well but will be most noticeable in well discharge after the well has been idle for some time. Some wells are infected so severly that the water will have a greenish tint to it. This water will always smell of decaying matter. If there is any doubt as to the safety of well water for human or livestock consumption, a sample should be sent to the Colorado Department of Health in Denver, Colo.

Bacterial Habits

Bacteria of this type can be spread from well to well by direct water injection or by the use of contaminated tools in a well. The bacteria appear to be most prevalent in wells used with oil lubricated turbine pumps, especially where excess oil is allowed to drip and accumulate on the water surface in the well. Bacteria are able to grow and survive in moving water as well as still water, but they seem to grow best in the pump column. When the bacteria are exposed to sunlight and air, they dry out and become flaky. These well bacteria will grow and survive in the pump column above static water level. They have been seen to actually progress from there into underground pipelines.

Treatment of the Well

Lye, also known as caustic soda or sodium hydroxide (NaOH), is recommended as a practical and inexpensive chemical for cleaning bacterial slimes from wells. *Lye is a strong chemical and can be dangerous when misused or used carelessly!* It is readily available in 100-pound (45.4-kilogram) lots, granular form, and can be ordered through drug stores. Well chemical manufacturers also have chemicals available that are premixed with lye, corrosion inhibitors and wetting agents. Lye also is a descalant and will remove rust formations and certain organic coatings from pump and well parts. Lye should never be pumped through pipelines that cannot be readily flushed.

The amount of lye used in well treatment is determined by well diameter and depth of water in the well. It is desirable to have about a 0.3 percent solution of lye, by weight of water, in the well. It is also helpful to add about 5 percent (by weight of lye) low-foam detergent or wetting agent to the lye-water mixture. Table 1 can be used to help select the correct amount of lye and detergent for **each 10 feet** (3.1 meters) of water in the well, according to well diameter.

*Example:*Evidence of bacterial slime is found in the well and the well needs to be treated. The well has a 16-inch (40.6-cm) diameter casing and 120 feet (36.6 m) of water in the well. How much lye and detergent should be ordered?

Answer: The first column of Table 1 should be followed down to 16-inch casing. To the right reads **18.7 lb/10 feet for lye** and **0.94 lb. for detergent.** Each of these should be multiplied by 12 (120 feet of water).

Lye - 18.7 x 12= **224 pounds.**
Detergent - 0.94 x 12 = **11.2 pounds.**

So, since lye is shipped in 100-pounds lots and detergent in 5- or 10-pound lots, **200** pounds of lye and **10** pounds of detergent should be orderd. *(To figure metric conversions, the following equivalents should be used: 1 inch = 2.54 centimeters; 1 pound = .45 kilogram; 1 foot = .30 meter.)*

Table 1: Amount of lye (NaOH) and detergent recommended per 10 feet (3.1 m) of water in well for various well diameters for a 0.3% solution.

Well diameter in inches (centimeters)	Pounds (kilograms) of 100% lye	Pounds (grams) of household detergent
4 in. (10.2 cm)	1.2 lbs. (.54 kg)	0.06 lbs. (27.2 g)
5 in. (12.7 cm)	1.9 lbs. (.86 kg)	0.10 lbs. (45.3 g)
6 in. (15.2 cm)	2.8 lbs. (1.3 kg)	0.14 lbs. (63.5 g)
8 in. (20.3 cm)	4.9 lbs. (2.2 kg)	0.24 lbs. (108.8 g)
10 in. (25.4 cm)	7.6 lbs. (3.4 kg)	0.38 lbs. (172.4 g)
12 in. (30.5 cm)	11.0 lbs. (4.9 kg)	0.55 lbs. (249.4 g)
14 in. (35.6 cm)	15.0 lbs. (6.8 kg)	0.75 lbs. (340.2 g)
16 in. (40.6 cm)	18.7 lbs. (8.5 kg)	0.94 lbs. (426.4 g)
18 in. (45.7 cm)	24.7 lbs. (11.2 kg)	1.24 lbs. (562.5 g)
20 in. (50.8 cm)	30.6 lbs. (13.9 kg)	1.50 lbs. (680.4 g)

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Items needed for the treatment job:
Crew of two, two 5-gallon (19-liter) mixing buckets for pouring, a 150- to 200-gallon (568-757-l) supply of clean water, a 4- to 5-foot (1.2-1.5-m) mixing stick, rubber gloves and goggles, small scoop to handle lye granules, a 1- or 2-inch (2.5-5.1-cm) flexible hose to run the lye into the well or column, a funnel to fit into the hose to be used, power unit to surge and pump well and extra pipe to pump waste.

Lye Treatment Procedure

Step 1. The pump base should be checked to see how the hose and funnel apparatus can be used on the particular pump. Ideally, half of the mixture should be poured between the pump column and well casing and the other half into the column. Well access holes vary in size and, occasionally, the access hole has been placed directly over the concrete base. On some pump makes, there are no access holes. If these last two conditions should exist, all the lye will need to be poured into the pump column through the discharge pipe. The hose can be used to feed the lye into the column.
Step 2. The bucket should be filled about three-fourths full with clean water, then enough lye scooped in to form a slurry that, after mixing, will flow easily through the hose. After adding a fraction of detergent to the mixture it can be poured into the well. *It should be remembered that lye attacks skin quickly* and should be handled with care. If any lye should come into contact with the skin and, especially the eyes, a person should stop pouring immediately and wash the area thoroughly with clean water. *Lye should not be handled in windy conditions.*
Step 3. After all the lye is poured into the well, about 50 gallons (189.3 l) of clean water should be poured into the same access holes so that metal parts are washed off as best as possible, then all the tools and any exposed skin parts, such as the arms and face should be carefully washed
Step 4. The lye solution should be allowed to remain undisturbed for 2 to 4 hours, then the pump started and the well surged briskly by pumping the water up to the discharge pipe, shutting down the power unit and allowing the water to fall back into the well. The well should be surged in this manner 3 to 4 times at 4- to 6-hour intervals.
Step 5. After 18 to 24 hours, the water in the well is ready to be pumped to waste. The water must be pumped to a waste area away from livestock where it will not cause a pond in the field. The waste water contains sodium and should not be allowed to stand on farm land. In the process of pumping to waste, the well should be intermittently surged and pumped until the water is *clear*. After at least one hour of pumping clear water, the well is ready for irrigation use.
Step 6. A prevention program should be planned to ensure the well will stay clean.

Prevention of Bacterial Growth

The most positive prevention against bacterial slimes is to make sure that any equipment, tool, or device used for well drilling or pump servicing is disinfected before it is used in the well.

Another practical method of prevention is to chlorinate the well after servicing or drilling and, subsequently, chlorinate the well at least one each year. Chlorination should be done in amounts according to Table 2. Table 2 shows chlorine needed per 10 feet (3.1 m) of water in the well.

Oil appears to provide an ideal environment for these bacteria; therefore, irrigation pump operators are advised to use turbine oil only in the amount required for pump operation. Oil drippers often are left to drip when the pump is idle, or they drip oil faster than needed by the pump.

Where chlorination is impractical, bacterial growths may be prevented by using a turbine-pump oil that contains an additive that inhibits bacterial growth. At least one common turbine-oil supplier sells this type of oil in bulk. A supplier of well treatment chemicals produces an additive that can be mixed with the turbine-pump oil. Either way, these additives appear to be very effective.

The chlorination process is done much the same as lye treatment, except that household bleaches and dry chlorine are safer and easier to handle. Calcium hypochlorite is dry and preferably should be mixed with water before putting it into the well. Agitation of the water by surging is very important for successful chlorination. The chlorine should be placed in the well overnight or for at least four hours. The wastewater then should be pumped until it is clear and free of the chlorine smell.

For further information, the local Colorado State University extension agent may be consulted.

Table 2: Chlorine amounts recommended for various chlorine sources, and various well diameters per 10 feet (3.1 m) of water in the well for a 100 ppm solution.

Well diameter in inches (centimeters)	Quarts (milliliters) of various strength bleach			Pounds (grams) of dry calcium hypochlorite
	5%	7%	10%	70% chlorine
4 in. (10.2 cm)	0.05 qts (47.3 ml)	0.04 qts. (37.8 ml)	0.03 qts. (28.4 ml)	0.01 lbs. (4.5 g)
5 in. (12.7 cm)	0.08 qts. (75.7 ml)	0.06 qts. (56.8 ml)	0.04 qts. (37.8 ml)	0.015 lbs. (6.8 g)
6 in. (15.2 cm)	0.12 qts. (113.5 ml)	0.09 qts. (85.1 ml)	0.06 qts. (56.8 ml)	0.02 lbs. (9.1 g)
8 in. (20.3 cm)	0.21 qts. (198.7 ml)	0.16 qts. (151.4 ml)	0.10 qts. (94.6 ml)	0.04 lbs. (18.1 g)
10 in. (25.4 cm)	0.33 qts. (312.2 ml)	0.25 qts. (236.5 ml)	0.16 qts. (151.4 ml)	0.06 lbs. (27.2 g)
12 in. (30.5 cm)	0.47 qts. (444.6 ml)	0.35 qts. (331.1 ml)	0.24 qts. (227.0 ml)	0.08 lbs. (36.3 g)
14 in. (35.6 cm)	0.64 qts. (605.4 ml)	0.48 qts. (454.1 ml)	0.32 qts. (302.7 ml)	0.11 lbs. (49.9 g)
16 in. (40.6 cm)	0.80 qts. (756.8 ml)	0.60 qts. (567.6 ml)	0.40 qts. (378.4 ml)	0.14 lbs. (63.5 g)
18 in. (45.7 cm)	1.06 qts. (1002.8 ml)	0.80 qts. (756.8 ml)	0.53 qts. (501.4 ml)	0.19 lbs. (86.2 g)
20 in. (50.8 cm)	1.30 qts. (1229.8 ml)	0.98 qts. (927.1 ml)	0.65 qts. (614.9 ml)	0.23 lbs. (104. 3 g)